Management of equine keratomas

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looks at successfully diagnosing a keratoma, before moving on to consider the three available surgical approaches to excision, and potential complications

ABSTRACT

A keratoma is a rare cause of lameness in horses. It typically arises from the epidermal keratin-producing cells of the stratum germinativum of the coronary band; however, keratomas can arise from any part of the inner surface of the sole or hoof wall. Clinical examination findings can be variable; often a history of recurrent subsolar abscessation is described. Keratomas are commonly diagnosed using radiography. Typical radiographic findings show a focal, smoothly demarcated area of radiolucency within the distal phalanx as a result of pressure from the keratoma on the bone.

Three surgical techniques have been reported for surgical excision of keratoma – complete hoof wall resection from the coronary band to the sole; partial wall resection directly over the keratoma; and a supracoronary approach. Choice of surgical procedure is predominantly guided by the proximal extent of the abnormal tract. The most clinically significant, although uncommon, postoperative complication is recurrence of the keratoma. It is accepted recurrence generally occurs if excision is incomplete or local tissue is incompletely debrided. Hoof wall stability after hoof wall resection is the basis of postoperative farriery. Assuming complete removal, the prognosis for return to soundness after surgical excision of a keratoma is excellent.

Keywords: keratoma, hoof wall resection, radiography, equine, lameness

THE aetiology of keratomas is unknown. A number of potential predisposing factors have been suggested, but the lack of consistent histological findings makes their significance difficult to determine.

It has been suggested they arise from previous trauma (Wagner, 1986), infection/subsolar abscessation or chronic irritation of the sensitive dorsal laminae or sole corium through pressure/injury (Honnas et al, 1988; Chaffin et al, 1989).

Use of the term keratoma is misleading as it implies a neoplastic process. There is evidence to show this is not the case and it is, in fact, hyperplasia or an abnormal regeneration of superficial keratin.

Diagnosis

Clinical examination findings can be variable; often a history of recurrent subsolar abscessation is described. Examination of the foot can reveal localised bulging of the hoof wall or deviation of the white line, most commonly affecting the foot between the toe and quarter (Lloyd et al, 1998). Lameness is abolished by either a palmar digital nerve block or abaxial sesamoid nerve block, depending on location within the hoof.

Keratomas are commonly diagnosed using radiography. Typical radiographic findings show a focal, smoothly demarcated area of radiolucency within the distal phalanx as a result of pressure from the keratoma on the bone (**Figure 1**). If a defect is located, the surrounding bony margin is often smooth, in contrast to sepsis, which typically shows a sclerotic margin (Honnas, 1991).

Not all keratomas that cause radiographic changes show this typical semicircular defect in the distal phalanx; some cases will show a more osteolytic osteitis as a result of inflammation of an area of the distal phalanx.

Although a complete set of radiographic views is necessary to evaluate the foot, a standard 65° dorsopalmar view is useful to evaluate the border of the distal phalanx. Differential diagnoses for these radiographic findings include septic or non-septic pedal osteitis, benign or malignant neoplasms and osseous cyst-like lesions.

Although radiography is the most common imaging modality used to diagnose keratomas, Mair and Linnenkohl (2012) found out of 21 horses diagnosed as affected by keratomas after MRI, only 66 per cent had radiological changes consistent with them.

CT and MRI provide a number of advantages over radiography for keratoma diagnosis. By providing cross-sectional and three-dimensional reconstructed images, information with regard to location and extent can be gathered aiding surgical planning (Tucker, 2001). If available, it is the author's opinion these advanced imaging modalities should be used prior to surgical excision.

Histological diagnosis is always recommended to definitively diagnose a keratoma (**Figure 2**). Typically, microscopic examination reveals abundant keratin and squamous epithelial cells; occasionally, some granulation tissue and inflammatory cells are seen (Hamir et al, 1992).

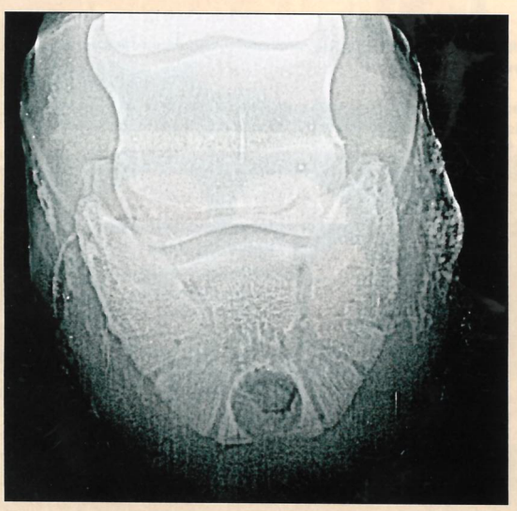

Figure 1. A smoothly demarcated area of radiolucency within the distal phalanx consistent with a spherical keratoma.

Figure 2. Histological examination is required to definitively diagnose keratoma.

Complete versus partial hoof wall resection

Three surgical techniques have been reported for surgical excision of keratomas: complete hoof wall resection from the coronary band to the sole; partial wall resection directly over a keratoma; and a supracoronary approach.

Choice of surgical procedure is predominantly guided by the proximal extent of the abnormal tract.

Generally, those tracts that extend to the coronary band are candidates for complete wall resection and those that do not extend to the coronary band are candidates for partial wall resection. Some cases will be exceptions to this rule and thorough surgical planning is key to a successful outcome.

Most keratomas can be excised standing; however, there are cases that will require general anaesthesia for removal. When performed standing, an abaxial nerve block should be placed to provide regional anaesthesia to the hoof, tourniquet applied around the fetlock for haemostasis and visualisation of the surgical site and sedation in stocks for safe restraint.

Complete hoof wall resection can be performed by making two parallel vertical cuts through the hoof wall either side of the abnormal tissue. Insertion of a metal probe into the draining tract is often useful to determine the direction, extent and to guide the position of the wall incision.

The two vertical cuts are then connected by two horizontal cuts, one at the white line and the other proximal to the keratoma, but below the coronary band. The author's preferred method is to use a cast cutting saw followed by a chisel to lever out the section of wall. Once removed, careful evaluation of the surgical site is essential to ensure the proximal and distal extents of the keratoma has been excised. Any necrotic tissue or debris should also be removed.

Partial hoof wall resection relies on accurate localisation of the keratoma; this can be done under radiographic guidance using radiodense markers or by CT or MRI-assisted excision.

A window is made in the hoof wall over the keratoma (**Figure 3**); the author prefers to use a cast cutting saw and chisel as previously described. However, a motorised burr or trephine would be suitable alternatives. It is not uncommon for the initial window within the hoof wall to be enlarged to allow complete removal or a second window to be made through the sole to gain complete access.

Partial wall resection is the preferred technique for keratoma removal because:

- stability of the hoof wall is maintained;
- complication rate is decreased when compared to complete wall resection (Boys Smith et al, 2006); and
- it offers faster return to full work than those undergoing complete wall resection.

Gasiorowski (2011) reports the use of a supracoronary approach to keratoma removal. An incision of 1cm to 2cm was made proximal to the coronary band and mass ligated and removed from its vascular pedicle. Given the dead space under the hoof wall defect, a full thickness vertical groove was made in the hoof wall distal to the mass to allow drainage.

Although an uncommon surgical technique for keratoma removal it provides a viable alternative to hoof wall resection for removal of non-solar keratomas.

Getman (2011) describes CT and MRI-assisted partial hoof wall resection. The advantages of these imaging modalities are two-fold: a smaller hoof wall resection can be made while still ensuring complete keratoma removal, but also a reduction in postoperative morbidity rates (20 per cent) is evidenced when compared with conventional surgical excision (Boys Smith et al, 2006).

It should be noted in addition to the aforementioned differences, the reduced postoperative morbidity rates could also be attributed to the use of an antimicrobial-impregnated collagen sponge and polymethylmethacrylate plug at the time of surgery as well as a glue-on shoe with carbon fibre patch over the plug. The reduction in morbidity rate is most likely to be a combination of all these factors.

Complications

The most clinically significant, postoperative complication is recurrence of the keratoma, but this is uncommon. It is accepted recurrence generally occurs if excision is incomplete or local tissue is incompletely debrided (Lloyd et al, 1988).

Logic would dictate recurrence is more likely to occur with partial wall resection, given complete removal at the time of surgery is based on direct visualisation. However, little evidence supports this; from the current evidence base, statistical analysis is not possible due to the small number of cases of recurrence in most studies.

Postoperative infection is a concern given the exposure of the pedal bone in the immediate postoperative period. Systemic antimicrobials are routinely used in combination with NSAIDs. Boys Smith et al (2006) reports the use of gentamicin sulphate-soaked swabs and metronidazole-soaked swabs to pack the hoof wall defect.

In the author's opinion antimicrobial-soaked swabs are unnecessary in these cases; packing the surgical site with silver dressings is an adequate prophylactic measure (Meaume et al, 2005; Jurczak et al, 2007).

Once a healthy covering of granulation tissue has formed, iodine swabs can be used to pack the deficit. If used before this point there is the potential for a caustic action on the surgical site (Kramer, 1999). Dressings should be placed immediately after surgery and changed daily for the first four days to allow the surgical site to be cleaned and repacked with fresh swabs.

Farriery

Hoof wall stability after hoof wall resection is the basis of postoperative farriery. Movement of the hoof capsule due to hoof wall instability can predispose to excessive granulation tissue formation (Stashak, 1991).

The shoeing necessary for stabilising the hoof wall depends on the surgery performed. In cases of complete wall resection a bar shoe should be placed with wide clips either side of the resected defect to prevent independent movement of the two sides of the hoof wall (Honnas et al, 2003). A bridging plate is necessary to prevent movement and

Figure 3. Partial hoof wall resection at two weeks after surgery.

Figure 4. Application of a bridging plate to maintain hoof wall stability after complete hoof wall resection.

Figure 5. Reconstruction of a hoof wall deficit using a polymethylmethacrylate filler.

provide stability while the hoof wall grows (**Figure 4**). In cases of partial wall resection a bar shoe should be placed as described for complete wall resection, but a bridging plate is unnecessary.

Reconstruction of the hoof wall deficit provides protection to the underlying laminae as well as stabilising the hoof capsule and allowing the horse to return to work more quickly (Frisbie and Trotter, 1998). The filler most commonly used is polymethylmethacrylate (**Figure 5**); premature filling of the defect can lead to damage to the underlying tissues by thermal necrosis as a result of the curing process and trapping bacteria under the filler itself.

With this in mind, proper hoof wall preparation is critical prior to application; an assessment of the thickness of keratinised tissue and removal of any loose horn or debris must be carried out prior to filling (Boys Smith et al, 2006).

Prognosis

The prognosis for return to soundness after surgical excision of a keratoma is excellent, assuming complete removal. In the study by Lloyd et al (1988) no recurrence was seen in seven cases one year to 11 years after removal. Bosch et al (2004) reports an 83 per cent return to previous or higher level of performance.

Although most keratomas reported in the literature show successful surgical removal of discrete masses, in the author's opinion a number of these masses are poorly defined and not as easy to demarcate from the normal corium and hoof wall. Removal of these poorly defined masses can be challenging; CT and MRI should be considered in these cases to reduce the risk of incomplete removal.

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